Center Innovation Fund: KSC CIF

Plume Mitigation: Soil Erosion and Lunar Prospecting Sensor

Completed Technology Project (2011 - 2013)

Project Introduction

A rocket exhaust with enough thrust for a lunar landing can propel rocks, sand, and dust, which can damage nearby assets such as a lunar outpost, a mining operation, or the historic sites of Apollo, Surveyor, or other missions. This is especially important because some of the Google Lunar X-Prize competitors intend to visit an Apollo site.

In order to develop strategies to mitigate the effects of ejecta, those effects must first be accurately predicted. We do not yet know how much soil is ejected during a lunar landing to within better than an order of magnitude, and this limits our accuracy in estimating how much damage ejecta will cause. The only way we can calibrate the erosion rate is to measure the optical density of the blowing dust clouds visible in the Apollo landing videos. However, because of uncertainties in the characteristics of the film used in the Apollo cameras 40 years ago, and because there is no calibration method available to remove camera uncertainties and background lighting effects, we can be no more accurate than an order of magnitude in our estimate of the erosion rate by that method. To improve our estimate, we must fly an instrument to the Moon, one specially designed to measure the rate of soil erosion under the rocket exhaust.

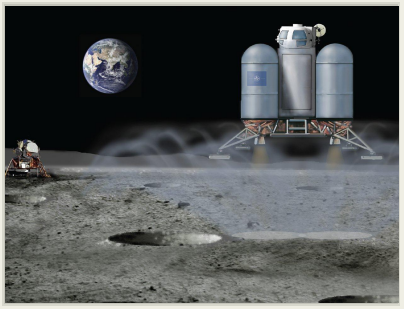
This project seeks to develop a sensor to measure blowing soil during a lunar landing and also provide a low-mass, low-cost, low-complexity alternative for detecting valuable mineral deposits. We plan to demonstrate feasibility of the simplest, lowest-mass method of measuring density of a cloud of lunar soil ejected by rocket exhaust and using new math techniques with a small baseline laser/camera system. The focus is on exploring the erosion process that occurs when the exhaust plume of a lunar rocket impacts the regolith.

Also, predicting the behavior of the lunar soil that would be blasted from a lunar landing/launch site shall assist in better design and protection of any future lunar settlement from scouring of structures and equipment. NASA is gathering experimental data to improve soil erosion models and understand how lunar particles enter the plume flow.

Anticipated Benefits

It is critically important for NASA to create reliable methods for predicting the risks and expected hardware damage from high velocity, ejected soil during lunar landings. These ejecta can sandblast and potentially ruin any sensitive hardware that exists at a lunar outpost, a lunar mining operation, or a historic Apollo site, when it is in the vicinity of a landing spacecraft.

There has also been increased economic interest by commercial space mining companies in extracting high-value metals from lunar or asteroid regolith. Space-based geological spectoscopy systems can be massive since they require an optical telescope to gain the fine spatial resolution required for



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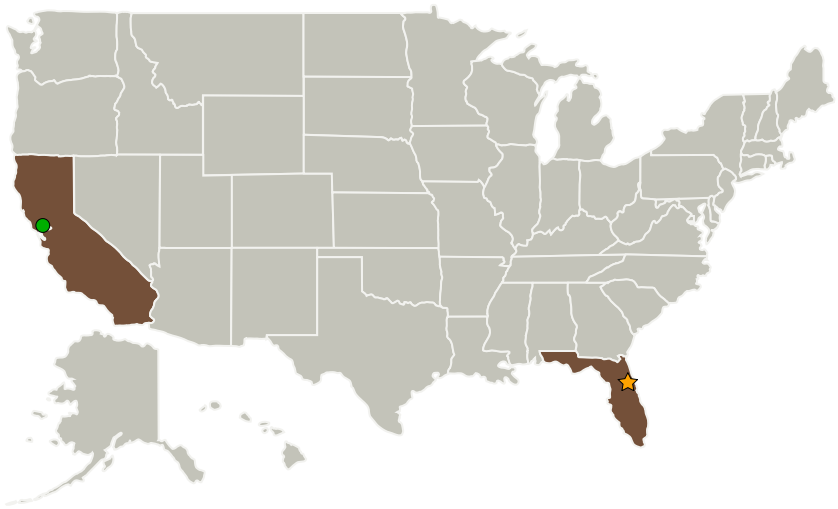
locating specific high-metal deposits.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
QinetiQ North America(QNA)	Supporting Organization	Industry	

Primary U.S. Work Locations	
California	Florida

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Barbara L Brown

Project Manager:

Nancy P Zeitlin

Principal Investigator:

Philip T Metzger

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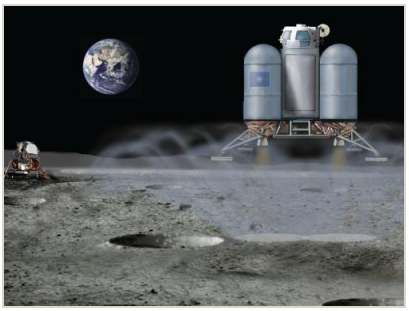
Images



Soil Erosion and Lunar Prospecting Sensor Project
Plume Mitigation: Soil Erosion and Lunar Prospecting Sensor
(https://techport.nasa.gov/image/2253)

Stories

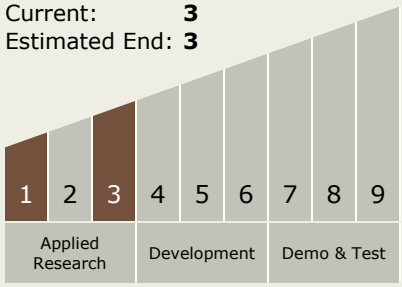
Lunar Surface Sensor May Help Detect Metals and Predict Rainfall
(https://techport.nasa.gov/file/1222)

Links

Numerical Simulation of Rocket Exhaust Interaction with Lunar Soil
(no url provided)

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.1 Destination Reconnaissance and Resource Assessment